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PN 64.2702/7
26 September 1974

MEMORANDUM FOR THE RECORD

SUBJECT : Joint US-USSR Proposals for Cooperation in Science and Technology: Water Resources Cooperative Area

1. We have reexamined the Joint US-USSR Proposals for Cooperation in Science and Technology: Water Resources Cooperative Area. Our overall opinion of the bilateral agreement is the same as stated in November 1972. We feel the agreement has been and will continue to be beneficial to both countries and that no loss of US strategic technology will occur.

2. We do not believe that any significant new knowledge has been produced thus far. Most of the activity that has taken place thus far has been the exchange of technical information, bibliographic materials, and planning of future exchanges of scientific delegations.

3. We have seen no intelligence reporting that indicated a different Soviet attitude than that reflected in the official reports of the Project Working Group. Virtually all of our information on Soviet water resources comes from unclassified Soviet periodicals, newspaper accounts, and radio broadcasts. These sources indicate a strong desire on the part of the Soviets to continue to cooperate and are optimistic on the benefits to the USSR.

4. The Soviets are undertaking cooperative agreements in the water resources area with countries in addition to the US. Most notable are their agreements with Great Britain

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and France. The USSR and Great Britain signed a five-year agreement on cooperation in the field of environmental protection on May 21, 1974. Areas included are the protection of waters from pollution and comprehensive utilization of water resources. The hydrological agreement with France includes topics such as irrigation, hydrometeorology, and the use of computers to forecast spring floods. Iran also has agreed to expand cooperation with the Soviets beyond the current joint project on the Araks river which borders the two countries.

5. We believe the agreement will be beneficial to the US even though the US is probably ahead of the Soviets in the majority of the areas in the agreement. The US Working Group on Planning, Utilization, and Management of Water Resources, which visited the Soviet Union in May 1974, was impressed with the magnitude of the Soviet water resources development program. Areas where the US should benefit the most appear to be cold weather construction, the use of polymer films, explosives excavation, and groundwater research. The Soviets have more experience than the US in working with concrete that is pre-cast rather than cast-in-place, but concrete work and quality control is below that of the US. The US should benefit from the extensive Soviet work in drainage especially as it affects salinity of the soils. Another benefit will accrue to the US if the Soviets increase purchases of such items as irrigation equipment and arrange to use US consultants to advise on water resource problems. The only disadvantage to the US could lie in the field of computer assistance in water resource management and control if the Soviets then utilize the automated techniques in more strategic areas.

6. Several additional areas exist that might make the agreement of greater benefit to the US. In the area of explosives excavation, a visit to the Amu-Bukhara Canal or the Nurek dam site, both in Soviet Central Asia, would be of value. Extensive Soviet work on salinity problems has not been explored sufficiently at this point. Attempts to learn more about Soviet drainage technology are recommended.

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7. Soviet benefits will come from the acquistion of US hardware and technological capability. The Soviets are seeking an automated total water resource program similar to that in the US, including the use of computers and mathematical models in the planning, design, and implementation of the programs. The Soviets also hope to gain information on large river basin diversion.

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RECORD

OF

THE SECOND US-USSR COORDINATORS MEETING ON PROJECT III 2, "METHODS AND MEANS OF AUTOMATION AND REMOTE CONTROL IN IRRIGATION SYSTEMS"

Frunze, Kirghiz SSR, USSR 24 September, 1974

I

In accordance with the US-USSR Agreement on Cooperation in the Field of Science and Technology, signed May 24, 1972 and the Results of Discussions of the first meeting of the US-USSR Joint Working Group on Scientific and Technical Cooperation in the field of Water Resources signed September 30, 1972, the second meeting of US-USSR coordinators was held in Frunze on September 24, 1974 on Project III 2, "Methods and Means of Automation and Remote Control in Irrigation systems".

Project coordinators, who headed the US-USSR Parties

The US Party: E.Sullivan
Assistant Commissioner-
Bureau of Reclamation

The USSR Party:
O.Bilik
Director of the All-Union Scientific Research Institute of Integrated Automation of Reclamation Systems

The list of participants is attached (Appendix N1).

The following items were under discussion:

1. Coordination of experimental projects for joint research

2. Consideration and approval of the Detailed Program of Works to be carried out during the second stage of cooperation for the period of 1975 and 1976.

II

1. As a result of exchange of opinions, the sides defined the general program of work for the period of cooperation (App.II) Agreement was reached on selection of the experimental project for joint research: in USSR-A Main Canal of the River Chu

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Basin (Kirghiz SSR) in USA-a Main Canal of the Sacramento River Basin (California).

In accordance with the agreement, reached at the coordinators' meeting in USA June 1974 the USSR side has prepared technological characteristics and requirement to be met by automated control system of the selected experimental project in the USSR, and commended them to the US side. The US side will present analogous documents for experimental project in USA to the USSR coordinator before the end of the year of 1974.

They developed and adopted a fully detailed program of work of the Second phase of cooperation for 1975-1976 (Appendix 5)

2. In accordance with the coordinated program of work of the second phase the coordinators found it appropriate to carry out a mutual exchange of specialists during the fourth quarter of 1975 for mutual discussion of results of research on experimental installations relating to points 1.2.1. of the program.

3. The American Group has been acquainted with the works of some water economy organizations of USSR and visited the following organizations:

-All-Union Administration of water projects desing VZO "Sojuzvodproject", Moscow.

-Middle Asian Research Institute of Irrigation, Tashkent.

-Uzbek SSR water projects.

-Kirghiz SSR water projects.

-Scientific Center-All-Union Scientific Research Institute of Integrated Automation of Irrigation Systems, Frunze.

4. The Project Coordinators and the participants of this Joint meeting state with satisfaction that the talks were held in an atmosphere of friendship and mutual understanding and contributed further development and extension of Cooperation in the field of Automation and Remote Control of Water Recource Systems.

The present record is signed on September 24, 1974 in two copies, Russian and English, both copies being equally valid

Mr. O.A.BILIK	Mr. E.SULLIVAN
PROJECT COORDINATOR	PROJECT COORDINATOR
THE SOVIET PARTY	THE US PARTY

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Appendix N 1.

List of Participants at Second Coordinator Meeting of US-USSR Sides on Project III "Methods and Means of Automation and Remote Control in Water Resources Systems".

US PARTY

E.F. SULLIVAN, US Project Coordinator, Assistant Commissioner-Resource Management, Bureau of Reclamation

CHARLES A. CALHOUN, Team Leader Water Systems Automation Devision of Water Operation and Maintenance Bureau of Reclamation Engineering and Research Center.

Professor P.F. FISCHBACH
University of Nebraska

LEONARD J. ERIE
Agricultural Research Service US Department of Agriculture Water Conservation Laboratory

VLADIMIR B. GRINIOFF
Interpreter, State Department.

USSR PARTY

O.A. BILIK, Project Coordinator Director, All-Union Scientific Research Institute of Integrated Automation of Reclamation Systems (VNIIKA Melioracii)

V.A. BESSARABOV-Deputy Director, VNIIKA Melioracii,

D.A. SUIUMBAEV, Deputy Director, VNIIKA Melioracii

E.E. MAKOVSKY, Department Chief, Institute of Automatics, Kirghiz SSR Academy of Science

VIACHESLAV I. KUROTCHENKO, Chief of Technical Cybernetics Laboratory, Institute of Automatics, Kirghiz SSR Academy of Science.

DMITRY D. KOZLOV, Chief Specialist of Automatic and Power Supply

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Department, V/O "Sojuzvodproject".

SVETLANA F.KORBUT, secretary, Soviet side of the Joint Water Resources Working Group, USSR Ministry for Reclamation and Water Management.

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Appendix N 2

Program of USSR-US Working Group on Scientific and Technical Cooperation in the Field of Water Resources

Project III-2"Methods and Means of Automation and Remote Control in Water Resource Systems"

N	Description	Activities at each item or phase	Executor in the USSR	Executor in the USA	Completion period	Expected results
1	2	3	4	5	6	7
1.	Design methods of automated systems to control technological processes in water projects including on-farm systems	Joint research on development and pilot operation of predetermined experimental projects.	VNIIKA reclamation; USSR Ministry of Land Reclamation and Water Management, Inst. of Automation, Kirghiz SSR Academy of Sciences	Bureau of Reclamation	1980	Automated experimental projects; recommendations on design and operation.
1.	Analysis and selection of experimental projects	Agreement of experimental projects selected during visits of	Coordinator	-"-	1974	Protocol

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1	2	3	4	5	6	7
USSR-US specialists in USA (June 1974) and USSR (September 1974)						
1.2	Scientific substantiation and preparation of assignment for design activities	Joint development of requirements to be met by control system, substantiation of assesment criteria, concepts, and algorithms for control, information and technical schemes, main requirements for program and technical facilities.	VNIIKA reclamation; Sojuzvodproekt; Inst. of Automation Kirghiz SSR Academy of Sciences	Bureau of Reclamation	III quarter 1976	Report or scientific substantiation, on technical assignment approved
1.3	Preparation of technical project and drawings	Agreement and exchange of technical information	Design Institute	-"-	1977	Technical project and drawings

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1	2	3	4	5	6	7
1.	Construction, assembly, and check-up	Activities at experimental projects and exchange of consultations	Construction and assembly organizations of USSR Ministry of Land Reclamation and Water Management	Bureau of Reclamation	1978	Acception Acts.
1.	Provision of tests at experimental project	Joint team	VNIIKA Reclamation	-"-	1979	Report on tests provision
1.	Recommendations on design and operation	Agreement and exchange of technical information	Sojuzvodproekt VNIIKA Reclamation	-"-	1980	Protocol on recommendations approved
2.	Complex of technical and program facilities for automated systems development to control technological processes in water projects, including on-farm systems	Joint research to develop and use new and existing complexes of technical and program facilities, their metrological provision and pilot operation	VNIIKA Reclamation; Inst. of Automation, Kirghiz SSR Academy of Sciences; Gosstandard; Minpribor	-"-	1979	Complexes of technical facilities, and recommendations on their use

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1	2	3	4	5	6	7
.1	Analysis of existing control and management facilities, and local automated systems as well	Exchange of technical information	VNIIKA reclamation; Soyuzvodproekt; SANIIRI	Bureau of Reclamation	1975	Catalogues of control and management facilities in industries
.2	Operation of pilot automated facilities on experimental projects, recommendations on automated facilities application and utilization.	Joint team	VNIIKA reclamation	-"-	1977-1978	Protocol on recommendations approved.
	Technical facilities to provide scientific and metrological research necessary to develop automated control systems for technological processes in water projects	Exchange of information, technical materials, devices	Gosstandard, Minpribor; VNIIKA reclamation	-"-	1975-1976	Scientific report and data on metrological provision
4	Personnel training for developing and operating automated	Exchange of training programs,	VNIIKA reclamation; MGMI, TIIIMSH,	-"-	1976	Training program and glossary

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1	2	3	4	5	6	7
	control systems for technological processes in Water projects	manuals, preparation of English-Russian glossary.	Kirghiz SHI	Bureau of Reclamation		
	Automated irrigation systems	Exchange of information	VNIIKA reclamation	-"-	1975-1976rr.	Scientific reports and publications.

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APPENDIX N 3

DETAILED PROGRAM OF WORKS

to be executed during 1975 - 1976 between US-USSR Working Group in the Field of Water Resources on Project III 2 "Methods and Means of Automation and Remote Control in Irrigation Systems".

N	Description	Activities at each item or phase	Executor in the USSR	Executor in the USA	Completion period	Expected results
1	2	3	4	5	6	7
.2.	Scientific justification and development of technical requirements for design.	Joint development of requirements for control system, basis of assessment criteria, concepts and algorithms control, information and technical schemes, main requirements for program and technical facilities.	VNIIKA reclamation, Sojuzvodproject, Institute of Automation, Kirghiz SSR Academy of Science.	Bureau of Reclamation for all activities	1976 III quarter	Report on scientific basis, record on technical assignment approved.

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1	2	3	4	5	6	7
.2.1	Research on technical and operational characteristics of experimental project.		VNIIKA reclamation, USSR Ministry of Land Reclamation and Water Management.		III quarter 1975	Report on project study results.
.2.1	1.Development of methods for data collection on technical and operational characteristics of canals and main structures.		VNIIKA reclamation		I quarter 1975	Methodology of collection of characteristics of canals and structures.
.2.1	2.Collection of technical and operational characteristics of water systems and related installations.		VNIIKA reclamation, Kirghiz SSR Ministry of Land Reclamation and Water Management.		II quarter 1975	Channels and structures characteristics.
.2.1.3.	Generalization and analysis of existing con-					

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1	2	3	4	5	6	7
	dition of a water system.		VNIIKA reclamation, Kirghiz SSR Ministry of Land Reclamation and Water Management.		III quarter 1975	Report on generalisation and analysis results.
1.2.2.	Development of assessment criteria, concepts and algorythms for control.		VNIIKA reclamation, Institute of Automation		I quarter 1976	Report
1.2.3.	Development of informational and technical network of automated control system by technological processes on experimental projects.		VNIIKA reclamation		II quarter 1976	Technical requirements for informational and technical network.
1.2.4.	Technical and economical basing for efficient automation of installations.		VNIIKA reclamation, Sojuzvodproject		II quarter 1976	Technical and Economical justification.

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1	2	3	4	5	6	7
1.2.5.	Development and coordination of performance specification for design of experimental project		VNIIKA reclamation, V/O Sojuzvodproject.		III quarter 1976	Performance specifications approved for experimental project design.
1.3.	Development of technical project and drawings.	Agreement and exchange of technical information.	Design institute.		1977	Technical project and drawings.
2.1.	Analysis of existing control and management facilities, and local automated systems as well.	Exchange of technical information.	VNIIKA reclamation, Sojuzvodproject.		IY quarter 1975	Catalogues of control and management facilities in industries.
2.1.1.	Analysis of measuring means		VNIIKA reclamation, Sojuzvodproject.		III quarter 1975	Catalogue of measuring means.

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2	3	4	5	6	7
1.2. Analysis of control technique		VNIIKA reclamation, Inst. of Automation, Kirghiz SSR Academy of Science.		III quarter 1975	Catalogue of control technique.
1.3. Analysis of local automated system		VNIIKA reclamation		III quarter 1975	Catalogue of local automated system.
Technical facilities to provide scientific and water measuring research necessary to develop automated control system for technological processes in water projects.	Exchange of information, technical materials, devices.	Gosstandard, Minpribor, VNIIKA reclamation.		1975-1976	Scientific reports and data on metrological provision.

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1	2	3	4	5	6	7
4.	Personnel training for developing and operating automated control systems for technological processes in water projects.	Exchange of training programs, manuals, preparation of English - Russian glossary.	VNIIKA reclamation, MGMY, TIIIMSH, Kirghiz SHI		1976	Training program and glossary approved.

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Prepared by Soviet Project Coordinator for first meeting of Joint Project Group, June 1974

STATE OF PROGRESS IN THE USSR TO DATE ON THE PROJECT: re Nomie 11/21

"METHODS AND MEANS OF AUTOMATION AND REMOTE CONTROL OF IRRIGATION SYSTEMS"

The investigation into the methods and means of automation and remote control in the USSR has been conducted mainly within the framework of the program "To Develop Methods and Technical Means of Complex Automation of Water Diversion, Regulation, and Recording for the Main Structures of Irrigation Systems, thus Increasing the Productivity of Labor During Water Distribution and Application." The project has been divided into five independent parts:

1. Develop the technological basis for complex automation of irrigation systems according to irrigation zones and types of irrigation systems.

2. Develop and introduce methods and means of automating head-works supply of water to irrigation systems ~~and~~ with gravity-flow and ~~of our~~ pumped diversions.

3. Develop methods and means of complex automation of inter-farm open and closed irrigation networks and conduct tests on them in irrigation systems in various zones of the country.

4. Develop methods and means of automating on-the-farm open and closed irrigation networks in various zones.

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5. Develop and test means of controlling vertical drainage systems.

The following organizations have taken part in the work on these projects: The Ministries of Reclamation and Water Management, of Instrumentation Manufacturing, of the Means of Automation and Control Systems and the Academy of Sciences of the USSR and Union Republics.

The state of development of the above listed parts can be briefly characterized in the following manner:

Part I. Develop Technological Basis for Complex Automation of Irrigation Systems According to Irrigation Zones and Types of Irrigation Systems

As the result of work on Part I, "Basic Proposals for Automation of Typical Technological Processes in Reclamation and Water Management" has been completed. In these proposals the typical technological processes have been identified; the problems, degree, and stages of automation have been developed; and the features and the extent of their automation and the form of control of automated water-reclamation systems have been determined. At the present time, a new revised edition of the proposals is being prepared.

Using the probability approach, a method has been developed for computing the amplification factor and the lag time of automatic direct-

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and indirect-operating water-level controls. The program for computing these parameters on electrical computers has been compiled and refined.

As a result of the study of technological basis for canals in the valley-plain zone, recommendations had been made for the technological operation of automated water diversion of hydrocomplexes.

A specified volume of research was conducted on the problems of creating and introducing the principles ~~of~~ for structuring automated irrigation systems with cascade regulation of water discharges. At the present time, the ~~basis of theory and practice~~ theoretical and practical bases of such systems have been developed. An analysis of the test data shows that the introduction of cascade regulation makes it possible to obtain the essential economice advantage in irrigated farming, because of the reduction of unevenness in the water-conveyance graph within a system.

The work on the investigation of the technological schemes of automated irrigation sediment traps has been completed resulting in three original designs of automatic devices to control flushing sluices by using hydraulic and electric energy.

In the irrigation canals of the mountain-foothill zone, a system has been developed for automatic water-level control with external cross couplings. The system has been installed with hydraulically operated

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proposals for designing these systems have been developed and experimental investigations of a test system are being conducted. Work on classification of water reclamation systems and their components, such as their control features and the parameters of control and regulation, is in the final stages. As a result of this work there will be a different type of catalog of technical features and technological parameters of control, measurement and regulation.

Part II — Develop and Introduce Methods and Means of Automating Head-works Supply of Water to Irrigation Systems with and Gravity-flow ~~of our~~ Pumped Diversions

Investigations on this part were conducted for the purpose of creating the methods and means of measuring water level and discharge at headworks diversion structures, the methods and means of regulating the productivity of pumping units, control systems for pumping plants, and information-measurement systems for forecasting river runoff in systems when ~~in~~ unregulated water diversion ~~development~~, and control points ~~centers~~ for electric drives at headworks GTS 1/.

From measuring water level in reservoirs and dam piezometric wells, an acoustic digital level meter was developed and calibrated for

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measurements of 1/10 and 1/64 meter, a system of centralized control has been built based on this level meter, the test units of which are in operation on a number of projects. At the present time an acoustic level sensor and a system of centralized control of water levels have been given over to industry for mass production.

At a number of features a controlled electric drive is being operated in a "thyristor converter--dc motor" scheme recommended for use in field pumping plants with a unit capacity up to 165 kw. Also, a controlled electric drive is being operated in a scheme of ~~con-verters~~ rectifiers with asynchronous-valve cascades recommended for use in pumping plants with a unit capacity of 160 to 800 kw.

Investigations have been conducted on creating an automatic information-measurement systems for operational forecasting of runoff. The theoretical and experimental development is proceeding on the structure and operating conditions of such systems for collecting information on all parameters necessary for this purpose.

Investigations have been conducted on a microwave radio path in mountain-foothill and mountainous conditions, and recommendations have been made concerning the organization of radio remote control communication channels using typical microwave radio stations.

A hydrological model has been ~~seen~~ developed which is based on multiple regressive linear equations by means of introducing a linearity in the argument in the equation.

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According to the technical requirements for an enclosed automatic electric drive, control points have been developed for gates with screw hoists. At the present time these are in series production. Compilation of a catalog of the means of the control, measurement and regulation recommended for use in automation projects for head-works structures is being completed.

Part III — Develop Methods and Means of Complex Automation of Inter-farm Open and Closed Irrigation Networks and Conduct Tests on Them in Irrigation Systems in Various Zones of the Country

Development and research has been conducted on the design of in-channel water-measuring structures for open networks, for free-flow pipelines, and for various designs of closed turnouts. Tests have substantiated the design of slope measuring instruments made from double membrane-divided boxes, off-side level-gaging stilling well with dampling, and electromagnetic discharge meters for complex operating conditions in pumping plants. Working designs have been drawn up on the basis of the investigations conducted earlier for a double-component discharge meter in open regulated channels and devices for measuring flow velocity in open channels based on an induction method.

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A mathematical model has been developed for a localized system of automatic water-level (discharge) control in channels, and preliminary recommendations have been made for selecting the parameters of the means for local automated hydraulic equipment.

Laboratory and field investigations have been conducted on hydraulically operated devices for water level and discharge regulation.

Investigations have been conducted on the use of stands for modeling the means of local electric automation equipment for regulating water level and discharge, on the basis of which engineering methods for designing these automatic controls have been developed.

The development and testing of control points for enclosed electric drives for slave mechanisms in hydraulic structures (gates with screw hoists) have been completed. As a result of satisfactory testing of the operating efficiency of the control points as a whole and their individual components of establishing the reliability of the drive activated by signals from remote sensors or devices, and of the effectiveness of protecting these control points under various operating conditions, these control points have been recommended for series production.

Experimental investigations were conducted on the devices which make it possible to use transmission lines as communication channels.

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Based on a study of the static and dynamic characteristics of irrigation systems, recommendations have been made for methods of centralized dispatching control and regulation of water distribution.

The development and introduction of the means ~~of~~ for setting up dispatching points in irrigation systems have been completed. These include the following apparatus: Control boards, graphic control charts, dispatcher posts, digital printing elements, information receiving elements, control system elements, elements for signalling deviation of a parameter from normal, water level and discharge sensors with "shaft-code" converters (single-pass and multiple-pass).

The results of production testing is positive.

Part IV. Develop Methods and Means of Automating on-the-Farm Open and Closed Irrigation Networks in Various Zones

Specifications have been developed for the means of regulating and recording water discharges in on-the-farm networks.

Production testing has been conducted on water measuring devices for drain pipes in the wells of vertical and horizontal drains. A number of automatic devices have been developed for sprinkling machines,

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such as, head limiters, head regulators, and hydraulic drive devices. A complex of information elements have been completed for centralized data collection from automated systems of water application, including moisture sensors, salinity meters, and thermometers. Experimental-structural development of information-measurement systems for data collection on soil moisture has been completed. The system uses radio communication channels and has 40 control points at each of which 5 moisture sensors are installed.

Part V. Develop and Test Means of Controlling Vertical Drainage Systems

Investigations on this part have been conducted for the purpose for creating a technical basis for automatic control of vertical drain systems, development of systems for smoothing start-up and regulating the capacity of pumping units, production testing of developed control points for the units, and development and selection of remote control systems for regulating vertical drain wells.

At the present time vertical drain systems are being classified as to control features, basic specifications for control systems have been formulated, a physical-mathematical model of a vertical drain system necessary for developing algorithms for control of these features is being developed.

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Control points made from solid-state elements have been developed which made it possible to assure a smooth startup of vertical drain units. The production testing is now being conducted.

A specialized induction-type discharge meter has been developed for pumped vertical drain wells. Field testing of this meter is being conducted on a test-production project.

/s/ Bilik

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